OIPE SEP 07 2004 PATENT & TRADEMARK OFFICE

AF/IFW

PTO/SB/21 (04-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	10/077,509
Filing Date	February 15, 2002
First Named Inventor	Pan et al.
Art Unit	2661
Examiner Name	Steven Blount
Attorney Docket Number	I-2-0178.3US
Total Number of Pages in This Submission	

ENCLOSURES (*Check all that apply*)

- [x] Fee Transmittal Form
  - [x] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Response to Missing Parts/ Incomplete Application
  - [ ] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) ____________
- [ ] After Allowance communication to Technology Center (TC)
- [ ] Appeal Communication to Board of Appeals and Interferences
- [x] Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- [ ] Proprietary Information
- [ ] Status Letter
- [ ] Other Enclosure(s) (please Identify below):

Remarks

Duplicate copy of Appeal Brief

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	Jeffrey M. Glabicki Reg. No. 42,584 Volpe and Koenig, P.C.
Signature	[signature]
Date	9/1/04

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail stop Appeal Brief-Patent, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below.

Typed or printed name	Jeffrey M. Glabicki		
Signature	[signature]	Date	9/1/04

PTO/SB/17 (10-03)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 330.00

Complete if Known	
Application Number	10/077,509
Filing Date	February 15, 2002
First Named Inventor	Pan et al.
Examiner Name	Jung-Lin Pan
Art Unit	2661
Attorney Docket No.	I-2-0178.3US

METHOD OF PAYMENT *(check all that apply)*

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☒ Deposit Account:

Deposit Account Number: 09-0435

Deposit Account Name: InterDigital Communications Corporation

The Director is authorized to: *(check all that apply)*

☒ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, **except for the filing fee**

to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($)

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Extra Claims		Fee from below		Fee Paid
Total Claims		-	=	X		=	
Independent Claims		-	=	X		=	
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

**or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	330.00
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) ____________

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 330.00

SUBMITTED BY				(Complete *(if applicable)*)	
Name (Print/Type)	Jeffrey M. Glabicki	*Registration No. (Attorney/Agent)*	42,584	*Telephone*	215-568-6400
Signature	[signature]			*Date*	9/1/04

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of:	
	Pan et al.
Application No.:	10/077,509
Confirmation No.:	**5390**
Filed:	February 15, 2002
For: SINGLE USER DETECTION USER EQUIPMENT	
Group:	2661
Examiner:	Steven Blount

Our File: I-2-0178.3US

Date: August 31, 2004

APPEAL BRIEF

Mail Stop Appeal Brief -Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Further to the July 2, 2004 Notice of Appeal, Applicants hereby submit this Appeal Brief.

TABLE OF CONTENTS

ITEM		PAGE
(1)	REAL PARTY IN INTEREST	3
(2)	RELATED APPEALS AND INTERFERENCES	3
(3)	STATUS OF CLAIMS	3
(4)	STATUS OF THE AMENDMENTS	3
(5)	SUMMARY OF THE INVENTION	4
(6)	ISSUES	4
(7)	GROUPING OF CLAIMS	5
(8)	ARGUMENT	5
(9)	CONCLUSION	10

APPENDIX A - Pending Claims 11-14

(1) REAL PARTY IN INTEREST

The real party in interest is the assignee of record, InterDigital Technology Corporation.

(2) RELATED APPEALS AND INTERFERENCES

An Appeal Brief was filed on June 16, 2004 for U.S. Patent Application No. 09/814,346, which this application is a continuation, and a Notice of Appeal was filed on July 22, 2004 for U.S. Patent Application No. 10/077,527, which is also a continuation of U.S. Patent Application No. 09/814,346.

(3) STATUS OF THE CLAIMS

Claims 1-16 are the subject of this appeal and are attached in Appendix A. No other claims are pending. Claim 1 was provisionally rejected under judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 19 of co-pending Application No. 09/814,346 and claim 1 of co-pending application No. 10/077,527. Claims 1-16 were finally rejected under 35 U.S.C. 103(a) as being unpatentable over an IEEE publication "Joint Detection with Low Computational Complexity for Hybrid TD-CDMA Systems" by Benvenuto et al. ("Benvenuto et al.) in view of U.S. Patent No. 5,719,899 ("Thielecke et al.").[1]

(4) STATUS OF THE AMENDMENTS

A Reply Pursuant to 37 C.F.R. §1.116 was filed on June 4, 2004, after the April 5, 2004 Final Action. The June 4, 2004 Reply essentially provided arguments as to overcoming the 35 U.S.C. 103(a) rejection and offering to file a terminal disclaimer to overcome the obviousness double patenting rejection, if the 103(a) rejection was

---

1 In the Final Action and prior Office Action, the Examiner refers to "applicants admitted prior art (hereinafter AAPA)". However, applicants do not admit that all the information provided in the background is "prior art". The information in the background is provided to give a context for the invention and not as an admission that any of the contextual information is publicly known information or would constitute prior art. Applicants may provide information in the background that may not constitute prior art under the requisite statutes or case law, but have

withdrawn. A June 29, 2004 Advisory Action issued maintaining the final rejection of the claims.

(5) SUMMARY OF THE INVENTION

The invention provides a time division duplex code division multiple access user equipment. Application, page 3, ¶ [0018]. The user equipment receives a plurality of data signals in a time slot and each data signal experiences a similar channel response. Application, page 4, ¶ [0024]. An antenna receives radio frequency signals including the plurality of data signals. Application, page 4, ¶ [0024]. A demodulator demodulates radio frequency signals to produce a baseband signal. Application, page 4, ¶ [0022]. A channel estimation device estimates the similar channel response at a multiple of a chip rate of the combined signal. Application, pages 4-5, ¶¶ [0022] and [0025]. A data detector device constructs a channel response matrix representing a channel of the data signals or a channel correlation matrix based on in part the estimated channel response. Application, pages 8-11, ¶¶ [0035]-[0043], [0046] and [0047]. A spread data vector is determined based on in part a fast fourier transform (FFT) decomposition of a circulant version of the channel response or channel correlation matrix. Application, pages 12 and 15-16, ¶¶ [0046] and [0058]. The spread data vector is despread to recover data of the received combined signal. Application, page 11, ¶ [0044].

(6) ISSUES[2]

(1) Do claims 1-16 meet the requirements of 35 U.S.C. §103(a), as being patentable over Benvenuto et al. in view of Thielecke et al.?

---

provided the information to place the application in better context.
2 The claims were also provisionally rejected under obviousness-type double patenting. Applicants are willing to submit a Terminal Disclaimer to overcome that rejection, if the claims are otherwise deemed allowable. However, Applicant does not wish to file the Disclaimer at this time, in case the claims are not deemed otherwise allowable or

(7) GROUPING OF CLAIMS

The claims on appeal consist of two groups. Claims 1, 2, 9 and 10 are in Group 1 and claim 1 is the representative claim. Claims 3-8 and 11-16 are in Group 2 and claim 3 is the representative claim.

(8) ARGUMENT

Background

This application (U.S. Patent Application No. 10/077,509) was filed on February 15, 2002 and is a continuation of U.S. Patent Application No. 09/814,346, filed on August 24, 2001, which claims priority to U.S. Provisional Application No. 60/266,932 , filed February 6, 2001 and U.S. Provisional Application No. 60/268,587, filed February 15, 2001.

Issue (1): Do claims 1-16 meet the requirements of 35 U.S.C. §103(a), as being patentable over Benvenuto et al. in view of Thielecke et al.?

Benvenuto et al. uses a matrix A in the equalization and not a channel response matrix or a channel correlation matrix to determine a spread data vector, as recited in the claims. The structure of the A matrix is illustrated on page 619 of Benvenuto et al. as follows:

---

amendments are made in the present or related applications making that rejection moot.

$$
\mathbf{A} = \left[\begin{array}{cccc|c|cccc}
b_1^{(1)} & 0 & \cdots & 0 & & b_1^{(U)} & 0 & \cdots & 0 \\
b_2^{(1)} & 0 & \cdots & 0 & & b_2^{(U)} & 0 & \cdots & 0 \\
\vdots & \vdots & & \vdots & & \vdots & \vdots & & \vdots \\
b_{Q+1}^{(1)} & b_1^{(1)} & \cdots & 0 & \cdots & b_{Q+1}^{(U)} & b_1^{(U)} & \cdots & 0 \\
\vdots & & & & \vdots & \vdots & & & \\
b_{Q+L-1}^{(1)} & \vdots & & \vdots & & b_{Q+L-1}^{(U)} & \vdots & & \vdots \\
\vdots & & \vdots & & & \vdots & & \vdots & \\
0 & & \cdots & 0 & & 0 & & \cdots & 0 \\
\vdots & & & b_1^{(1)} & \vdots & \vdots & & & b_1^{(U)} \\
 & b_{Q+L-1}^{(1)} & & \vdots & \cdots & & b_{Q+L-1}^{(U)} & & \vdots \\
 & \vdots & & & & & \vdots & & \\
0 & 0 & \cdots & b_{Q+L-2}^{(1)} & & 0 & 0 & \cdots & b_{Q+L-2}^{(U)} \\
0 & 0 & \cdots & b_{Q+L-1}^{(1)} & & 0 & 0 & \cdots & b_{Q+L-1}^{(U)}
\end{array}\right]
$$

The "b" elements of that matrix are a convolution of the channel response of each user "g" and the specific signature sequence (chip code) "c" as described on page 619 of Benvenuto as follows:

> as $\mathbf{d}^{(u)}$. Each data symbol is spread with a user-specific signature sequence
>
> $$\mathbf{c}^{(u)} = [c_1^{(u)}, c_2^{(u)}, \ldots, c_Q^{(u)}]^T, \quad u = 1, \ldots, U, \qquad (1)$$
>
> . . .
>
> In the up-link the signal of each user passes through a different mobile channel characterized by its impulse response
>
> $$\mathbf{g}^{(u)T} = [g_1^{(u)}, g_2^{(u)}, \ldots, g_L^{(u)}], \quad u = 1, \ldots, U, \qquad (4)$$
>
> whose samples are taken at chip interval T_C. The combined effect of spreading and channel is represented by the convolution:
>
> $$\mathbf{b}^{(u)} = \mathbf{g}^{(u)} * \mathbf{c}^{(u)} = [b_1^{(u)}, b_2^{(u)}, \ldots, b_{Q+L-1}^{(u)}]^T. \qquad (5)$$

> **Following the approach of Klein *et al.* [4], the components of the vectors $\mathbf{b}^{(u)}$, $u = 1, \ldots, U$ are arranged in a system matrix of dimension $(NQ + L - 1) \times UN^1$ shown at the top of the page.**

Accordingly, the A matrix has elements of the code sequence and the channel responses. The proposed receiver of Benvenuto to al. can be modeled on page 620 of Benvenuto as follows:

$$\begin{aligned} \mathbf{r} &= (\mathbf{A}^H\mathbf{A})^{-1}\mathbf{A}^H\mathbf{e} & (9) \\ &= \mathbf{d} + (\mathbf{A}^H\mathbf{A})^{-1}\mathbf{A}^H\mathbf{n}. & (10) \end{aligned}$$

d as described on page 619 of Benvenuto is the data vector **d**. Using the above equation, the estimation of **d** would be modeled as $\mathbf{d} = \mathbf{r} - (A^H A)^{-1} A^H \mathbf{n}$. As a result, Benvenuto et al. discloses using the A matrix in a direct approach to estimate the data, **d**.

The present invention uses either a channel response matrix (Group 1) or a channel correlation matrix (Group 2) to determine a spread data vector. The spread data is a combination of the data and the spreading codes, as shown in the application on Page 11, ¶¶ [0041] and [0042], in part. As illustrated in Equation 17, the spread data vector $\underline{s}$ is a vector multiplication of the code vector **C** and the data vector $\underline{d}$. Accordingly, the use of the channel response matrix (Group 1) or cross channel correlation matrix (Group 2) and despreading is not disclosed by Benvenuto et al.

Furthermore, Benvenuto et al. does not even utilize a circulant version of the A or even $A^H A$ matrix, in contrast with a circulant version of the channel response matrix or the channel correlation matrix, as recited in the claims. Benvenuto et al. partitions the $A^H A$ matrix into many sub-matrices "T", as follows on page 620.

The idea is to partition the matrix $\mathbf{A}^H\mathbf{A}$ into U^2 Toeplitz $N \times N$ submatrices $\tilde{\mathbf{T}}_{i,j}$ of the form:

$$\tilde{\mathbf{T}}_{i,j} = \begin{bmatrix} t_0 & t_{-1} & \cdots & t_{-m} & \cdots & 0 \\ t_1 & t_0 & & t_{-m+1} & \ddots & \vdots \\ \vdots & & \ddots & & & t_{-m} \\ t_m & t_{m-1} & & & & \vdots \\ \vdots & \ddots & & & t_0 & t_{-1} \\ 0 & \cdots & t_m & \cdots & t_1 & t_0 \end{bmatrix}. \quad (15)$$

Each of these sub-matrices is approximated as a circulant matrix. A diagonal matrix is derived from each approximated circulant matrix, as follows at Benvenuto et al., page 620.

If $[t_0, t_1, \ldots, t_{-m-1}, t_{-m}]^T$ is the first column of the circulant matrix $\mathbf{T}_{i,j}$, we introduce the $N \times N$ diagonal matrix

$$\Gamma_{i,j} = N\mathrm{diag}\left\{\mathbf{DFT}\left[t_0, t_1, \ldots, t_{-m-1}, t_{-m}\right]\right\}. \quad (17)$$

The A^HA matrix is approximated using these diagonal matrices, as follows at Benvenuto et al., page 620.

$$\begin{aligned} \mathbf{A}^H\mathbf{A} &= \frac{1}{N^2}\mathbf{F}_M^H \begin{bmatrix} \mathbf{\Gamma}_{1,1} & \mathbf{\Gamma}_{1,2} & \cdots & \mathbf{\Gamma}_{1,U} \\ \mathbf{\Gamma}_{2,1} & \mathbf{\Gamma}_{2,2} & & \mathbf{\Gamma}_{2,U} \\ \vdots & & \ddots & \vdots \\ \mathbf{\Gamma}_{U,1} & \mathbf{\Gamma}_{U,2} & \cdots & \mathbf{\Gamma}_{U,U} \end{bmatrix} \mathbf{F}_M \\ &= \frac{1}{N^2}\mathbf{F}_M^H \mathbf{\Gamma} \mathbf{F}_M \end{aligned} \quad (20)$$

By contrast, the claims recite a circulant approximation of either the channel response matrix or the cross channel correlation matrix. As described in the specification, in part, at page 14, ¶¶ [0052] and [0062]. Applicants respectfully submit that one skilled in the art would not construe a circulant matrix as being a matrix having many circulant partitions.

Additionally, the circulant approximation creates an error (approximation error). In the present claims, this approximation error is limited, since the approximation is to the channel response or channel correlation matrix and limted to the far corners of the matrices. In Benvenuto et al., the approximation is repeated and throughout the A^HA approximated matrix. As a result, the Benvenuto et al. approximation has a more spread out (less isolated) approximation error, making correction of the approximation error extremely difficult, if at all possible.

Additionally, representative claims 1 and 3 recite multiple chip rate sampling. Benvenuto et al. does not disclose such sampling. Furthermore, applying multiple chip rate sampling to Benvenuto et al. changes the matrix structures in Benvenuto et al. preventing the application of the equalization technique described in that application. To illustrate, multiple chip rate sampling, such as at twice the chip rate, produces a received vector **r** and channel responses "g" of twice the length. One dimension of the various matrices of Benvenuto et al would be doubled in length. Furthermore, the Toeplitz structure of each partition would not exist, since an additional column would be inserted next to each column of the A matrix on page 619. Accordingly, the approach of Benvenuto et al. can not be applied to multiple chip rate sampling.

In the preceding, a comparison of the elements of Groups 1 and 2 were contrasted with the Benvenuto et al. reference, in some instances in the alternative. Although applicant believes for the above reasons that the claims of both Group 1 and Group 2 are allowable, it is respectfully requested that each group be considered separately.

Thielecke et al. is only cited for showing an antenna and demodulator are known in the art. However, that reference does not disclose taking a circulant version of a channel response or channel correlation matrix at all or following the processing of the circulant matrix by a despreader. Accordingly, the Benvenuto et al. and Thielecke et al. combination does not teach or suggest the present invention.

(9) CONCLUSION

For the reasons stated above, pending claims 1-16 meet the requirements 35 U.S.C. §103(a). Accordingly, the final rejection of the claims under 35 U.S.C. §103(a) should be reversed. After reversal, Applicant is willing to file a terminal disclaimer to overcome the provisional obviousness-double patenting rejection and, after filing the disclaimer respectfully requests that the pending claims be passed to allowance.

Respectfully submitted,

Pan et al.

By:____________________

Jeffrey M. Glabicki
Registration No. 42,584
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza, Suite 1600
30 South 17th Street
Philadelphia, PA 19103
JMG

APPENDIX A
(PENDING CLAIMS OF U.S. PATENT APPLICATION NO. 10/077,509)

1. A time division duplex using code division multiple access user equipment, the user equipment for receiving a plurality of data signals in a time slot, each data signal experiencing a similar channel response, the user equipment comprising:

an antenna for receiving radio frequency signals including the plurality of data signals;

a demodulator for demodulating radio frequency signals to produce a baseband signal;

a channel estimation device for estimating the similar channel response at a multiple of a chip rate of the combined signal; and

a data detector device for constructing a channel response matrix representing a channel of the data signals based on in part the estimated channel response, determining a spread data vector based on in part a fast fourier transform (FFT) decomposition of a circulant version of the channel response matrix, and despreading the spread data vector to recover data from the received combined signal.

2. The user equipment of claim 1 wherein the multiple of the chip rate is twice the chip rate.

3. A time division duplex using code division multiple access user equipment, the user equipment receiving a plurality of data signals in a time slot, each data signal experiencing a similar channel response, the user equipment comprising:

an antenna for receiving radio frequency signals including the plurality of data signals;

a demodulator for demodulating radio frequency signals to produce a baseband signal;

a channel estimation device for estimating the similar channel response; and

a data detector device for constructing a channel correlation matrix representing a channel of the data signals based on in part the estimated channel response, determining a spread data vector based on in part a fast fourier transform (FFT) decomposition of a

circulant version of the channel correlation matrix, and despreading the spread data vector to recover data from the received combined signal.

4. The user equipment of claim 3 wherein the combined signal is sampled at a multiple of a chip rate of the combined signal and the sampled combined signal is input into the channel estimation and data detector device.

5. The user equipment of claim 4 wherein the multiple of the chip rate is twice the chip rate.

6. The user equipment of claim 3 wherein the combined signal is sampled at a chip rate of the combined signal and the sampled combined signal is input into the channel estimation and data detection device.

7. The user equipment of claim 3 wherein the FFT decomposition is performed using a permuted first row of the channel correlation matrix.

8. The user equipment of claim 3 wherein the FFT decomposition is performed using a defining row of the channel correlation matrix.

9. A time division duplex using code division multiple access user equipment, the user equipment for receiving a plurality of data signals in a time slot, each data signal experiencing a similar channel response, the user equipment comprising:

means for receiving a combined signal over the shared spectrum in the time slot, the combined signal comprising the plurality of data signals;

means for sampling the combined signal at a multiple of a chip rate of the combined signal;

means for estimating the similar channel response;

means for determining a spread data vector based on in part a fast fourier transform (FFT) decomposition of a circulant version of the channel response matrix; and

means for despreading the spread data vector to recover data from the channel response matrix.

10. The user equipment of claim 9 wherein the multiple of the chip rate is twice the chip rate.

11. A time division duplex using code division multiple access user equipment, the user equipment receiving a plurality of data signals in a time slot, each data signal experiencing a similar channel response, the user equipment comprising:

means for receiving a combined signal over the shared spectrum in the time slot, the combined signal comprising the plurality of data signals;

means for estimating the similar channel response;

means for constructing a channel correlation matrix based on in part the estimated channel response;

means for determining a spread data vector based on in part a fast fourier transform (FFT) decomposition of a circulant version of the channel correlation matrix; and

means for despreading the spread data vector to recover data from the received combined signal.

12. The user equipment of claim 11 wherein the combined signal is sampled at a multiple of a chip rate of the combined signal and the sampled combined signal is input into the estimating and determining means.

13. The user equipment of claim 12 wherein the multiple of the chip rate is twice the chip rate.

14. The user equipment of claim 11 wherein the combined signal sampled at a chip rate of the combined signal and the sampled combined signal is input into the estimating and determining means.

15. The user equipment of claim 11 wherein the FFT decomposition is performed using a permuted first row of the channel correlation matrix.

16. The user equipment of claim 11 wherein the FFT decomposition is performed using a defining row of the channel correlation matrix.